

A photograph of a house with a lightning bolt striking the sky above it. The house is a single-story structure with a light-colored exterior and a dark roof. The sky is overcast and grey, with a bright white lightning bolt striking down from the top left. The house is partially obscured by trees in the background.

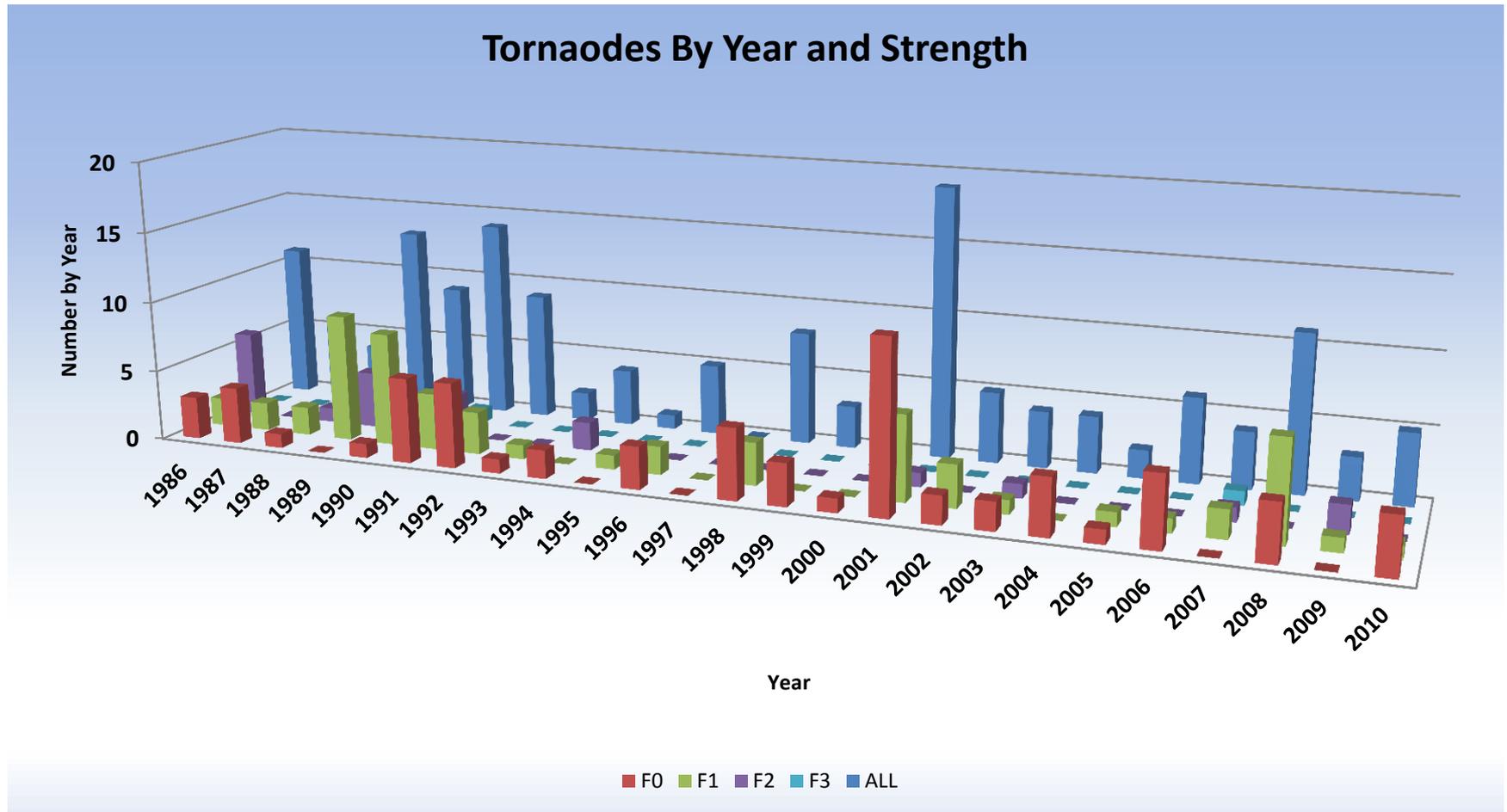
La Nina Springs and Severe Weather in Southwest Michigan

**Does having a La Nina
Impact
Severe Weather Frequencies?**

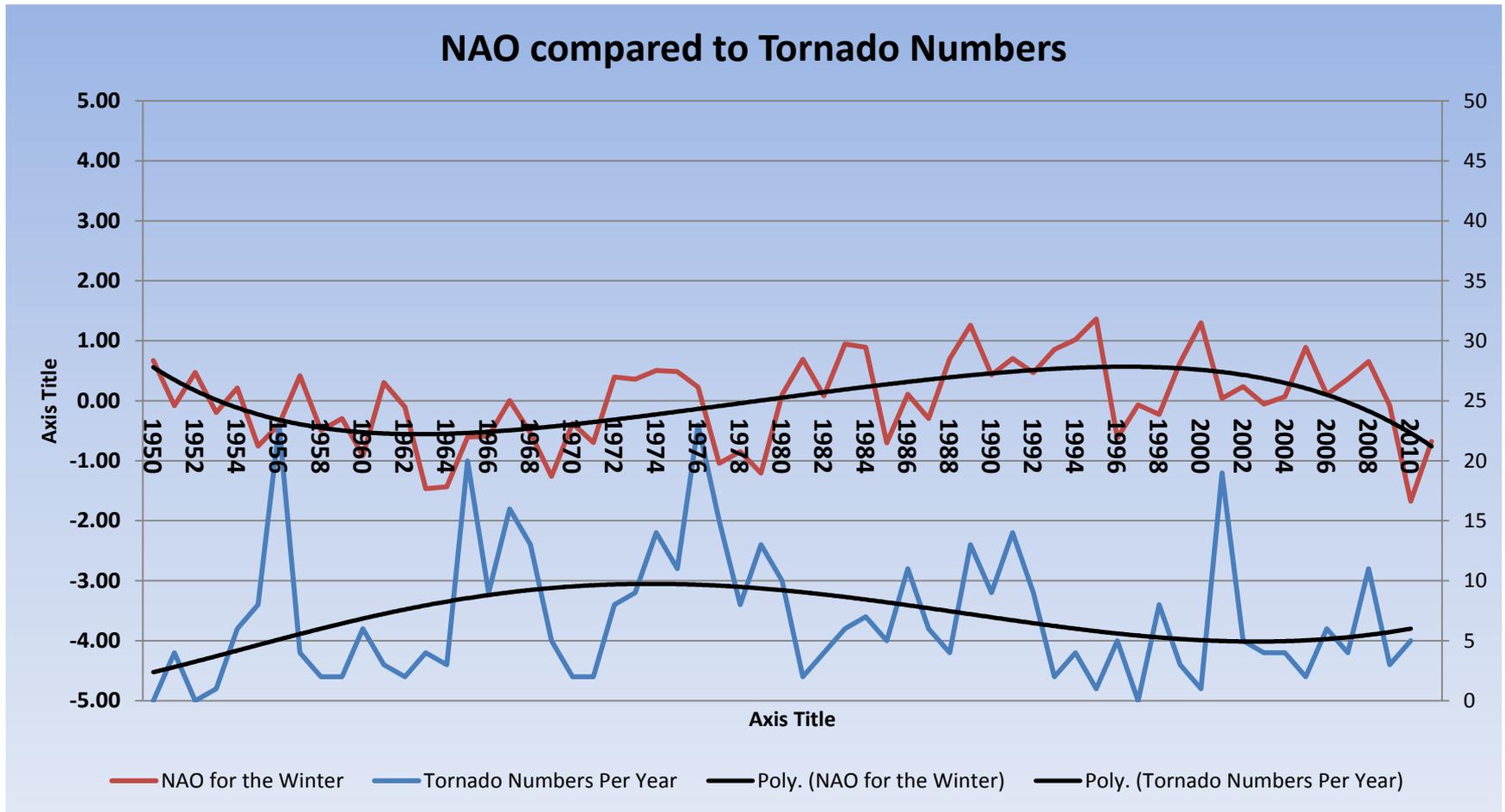
What We Will Look At

- Tornadoes frequency since 1950
- Trends of Tornadoes since 1950
- Mean Number of Tornadoes by Phases of ENSO
- Tornado Frequency as a function of ENSO phase
- Severe storms by season for La Nina and El Nino
- Severe Storms by Season for ENSO phase
- Possible reason for difference in numbers by ENSO type
 - Mean Jet Stream for La Nina
 - El Nino in winter and spring

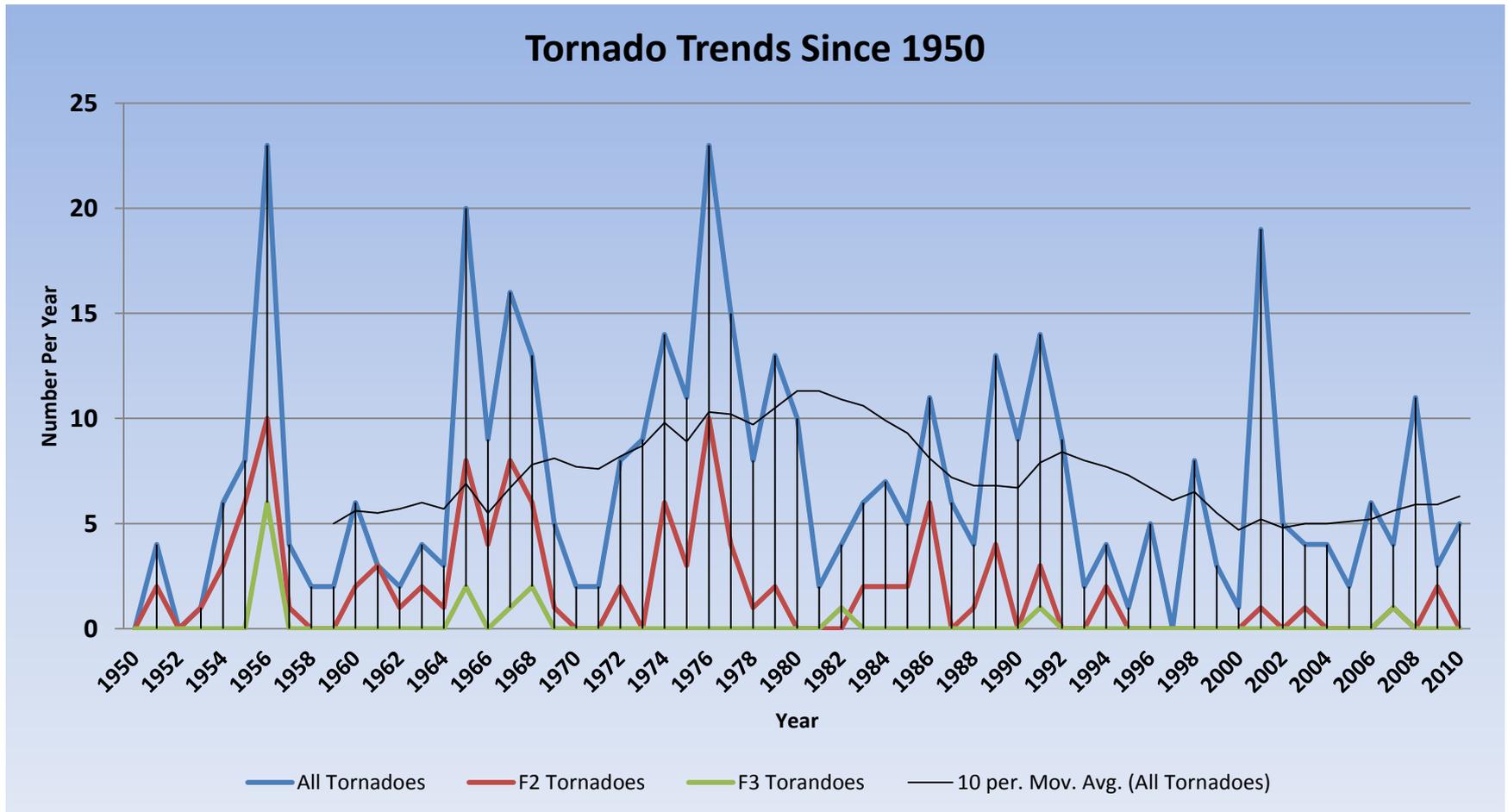
Tornado Trends By Year for the GRR CWA



Tornado Numbers and Winter NAO



Tornado Trends Since 1950



All peak years for Tornadoes, since 1950, had a **moderate or strong La Nina** the preceding winter.

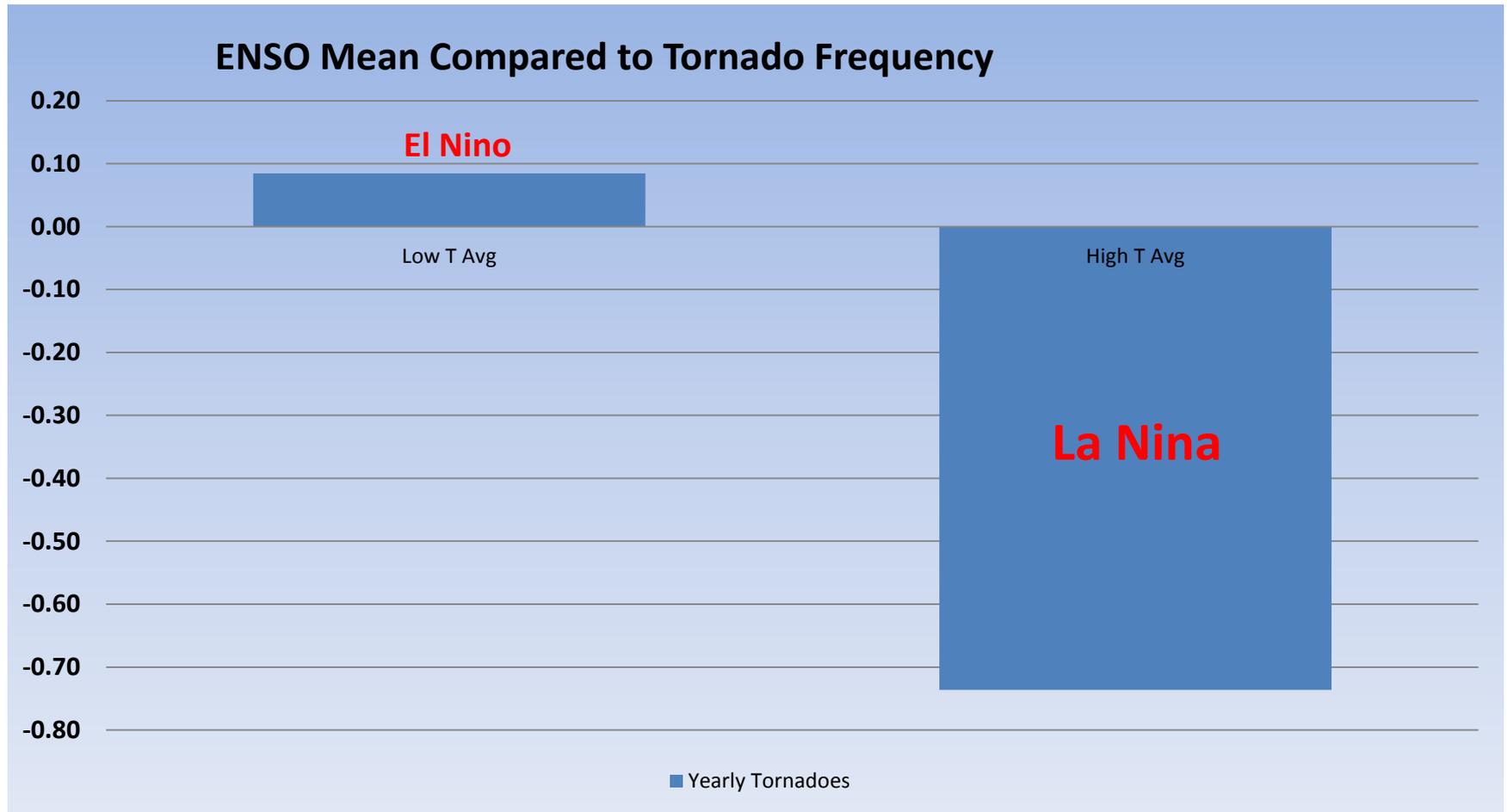
Tornado – ENSO Index – NAO Index

Tornado Peaks - NAO - ENSO				
NAO	ENSO	Year	Severe	TORNADO
0.67	-1.2	1956	41	23
-0.08	-1.6	1976	90	23
0.47	-0.8	1965	51	20
-0.20	-0.7	2001	159	19
0.21	-0.4	1967	38	16
-0.76	0.6	1977	35	15
-0.39	-1.8	1974	58	14
0.42	0.4	1991	106	14
-0.49	-0.1	1979	52	13
-0.30	-0.7	1968	54	13
-0.91	-1.8	1989	45	13
0.31	-0.6	1975	97	11
-0.11	-0.5	1986	37	11

Tornado Trends

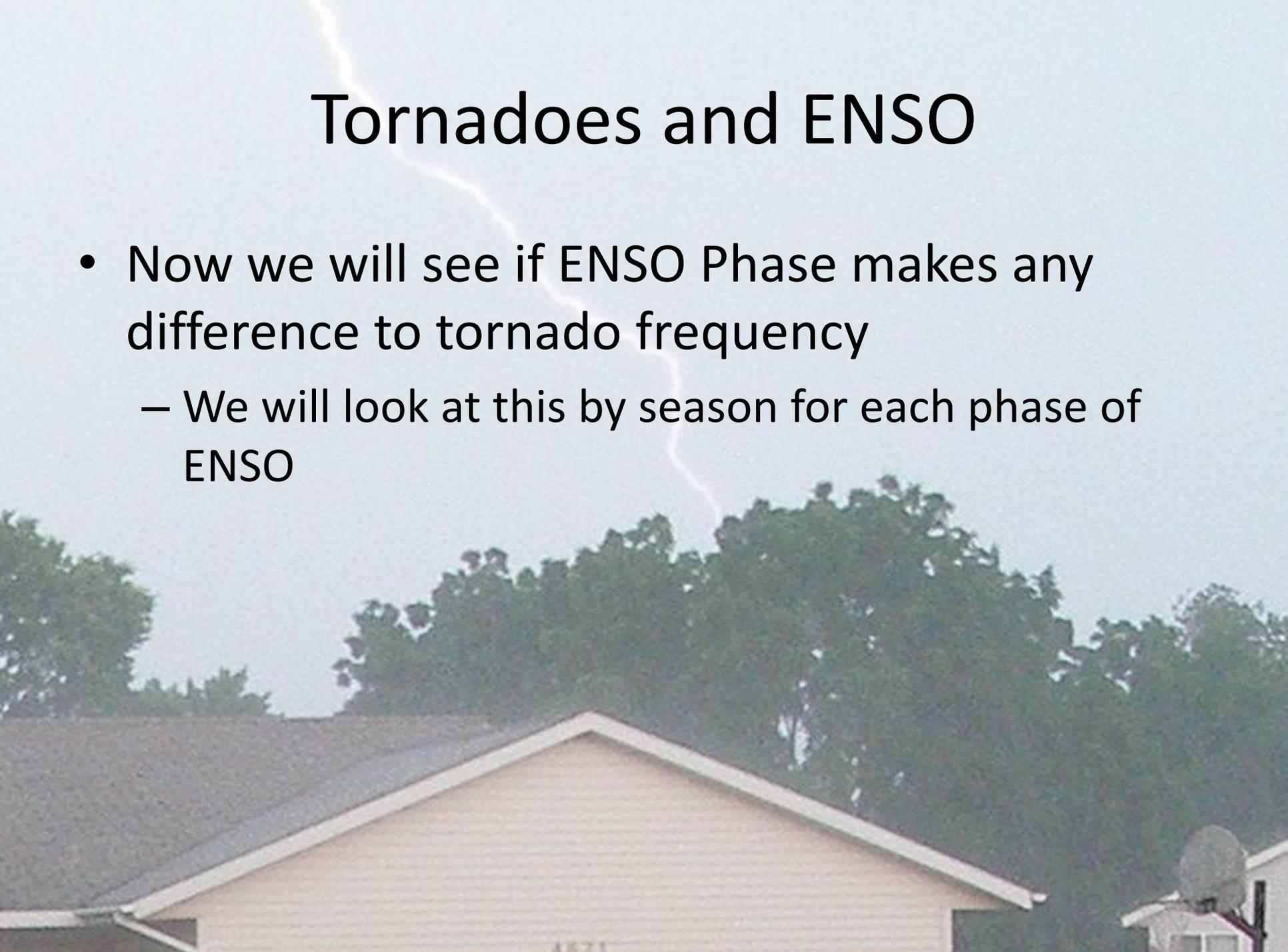
- No statistically significant change in tornado numbers, by year since 1950
 - There is an average of 12 years between peaks and minimums in yearly Tornado Number
- Seems to be some relation to the NAO
 - NAO negative , tornadoes are more frequent
 - NAO positive , tornado numbers are suppressed
- **La Nina** actually is a bigger player for increased tornadoes

Compare Mean ENSO for High and Low Numbers of Tornadoes

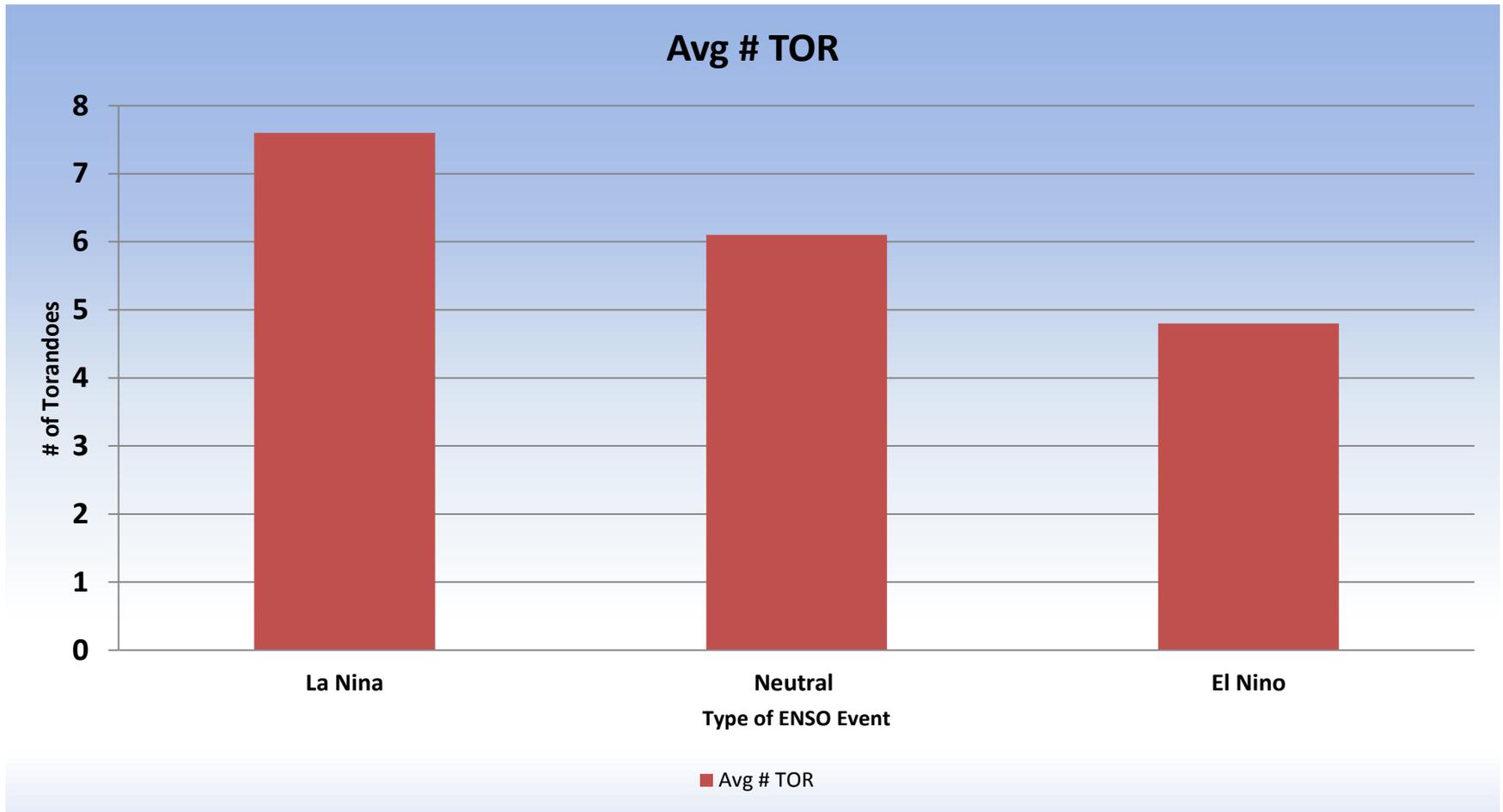


Tornadoes and ENSO

- Now we will see if ENSO Phase makes any difference to tornado frequency
 - We will look at this by season for each phase of ENSO



Tornado Frequency By ENSO Event



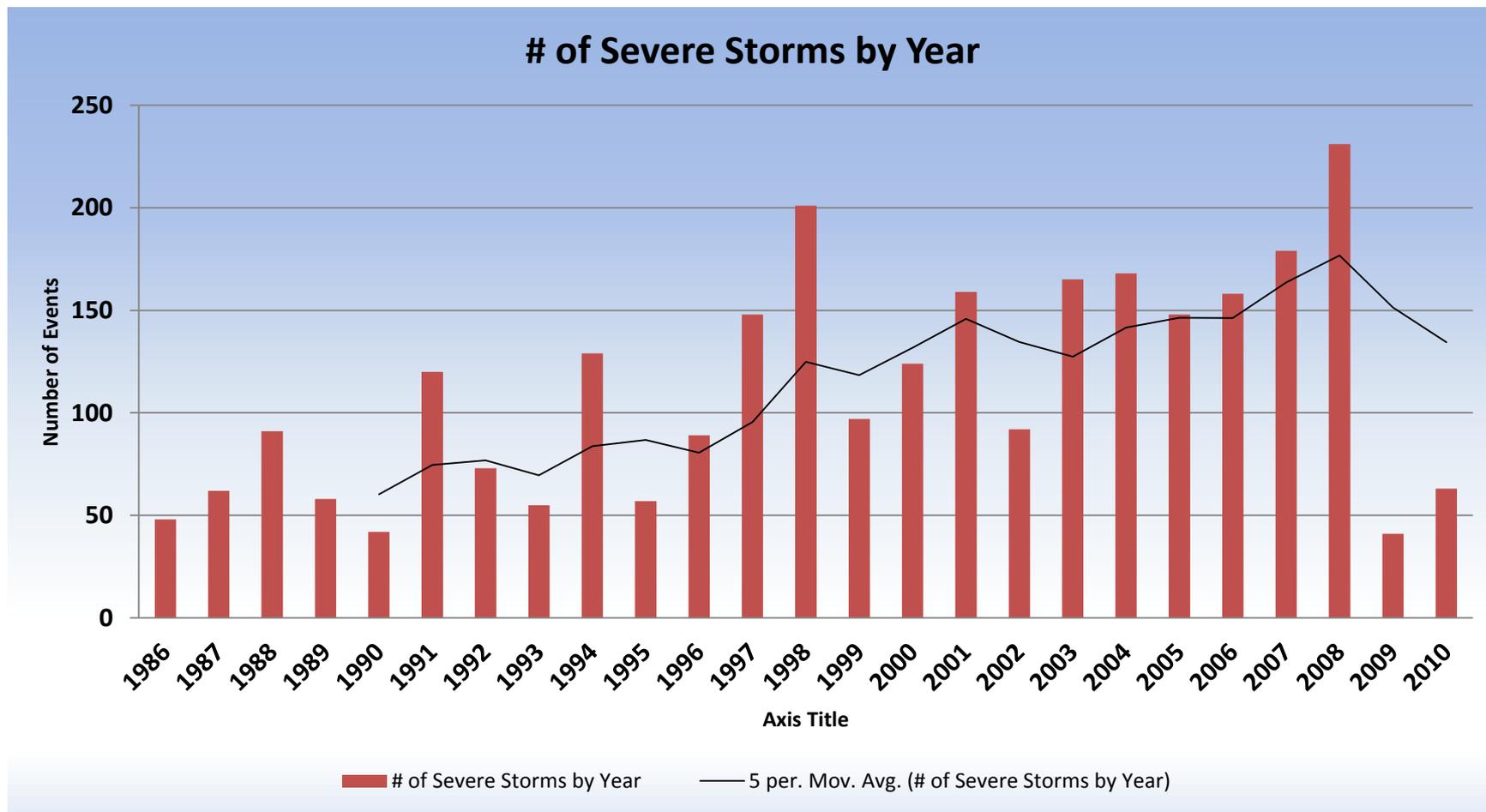
Results

- For La Nina, there is a statistically significant increase in tornado frequency at the 95 % confidence level
- **All of the peaks** in tornado frequency since 1950 have been years with a moderate or stronger La Nina during the winter preceding the event
- For La Nina we average about 8 tornados per season since 1950
- For El Nino we average around 5 per year since 1950

Now Let's Consider Severe Storms in General

- Does ENSO phase have an impact of severe storm frequency?
- Does ENSO phase impact which season of the year severe storms are most prominent?

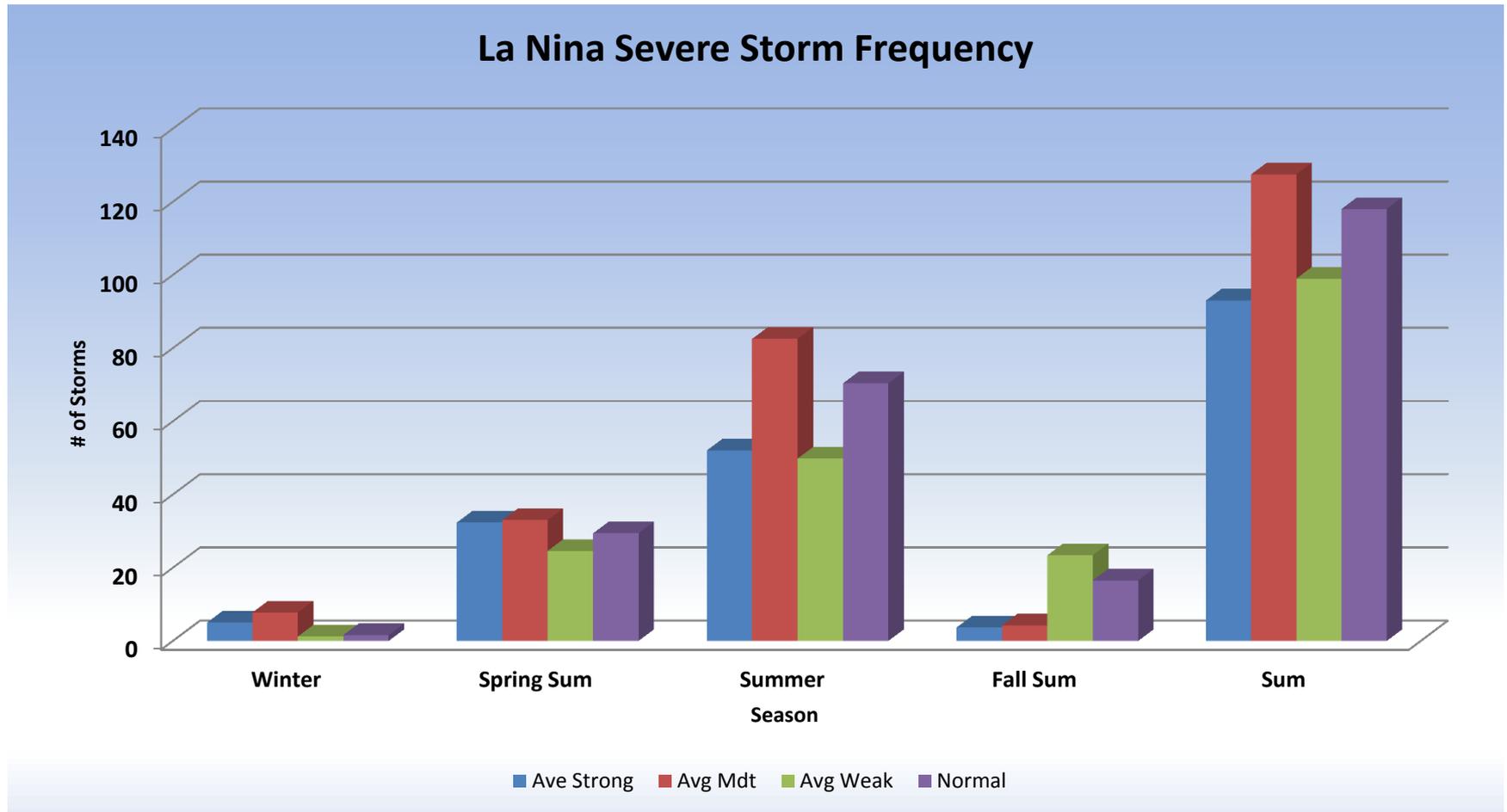
Severe Storm Frequency for the GRR CWA since 1986



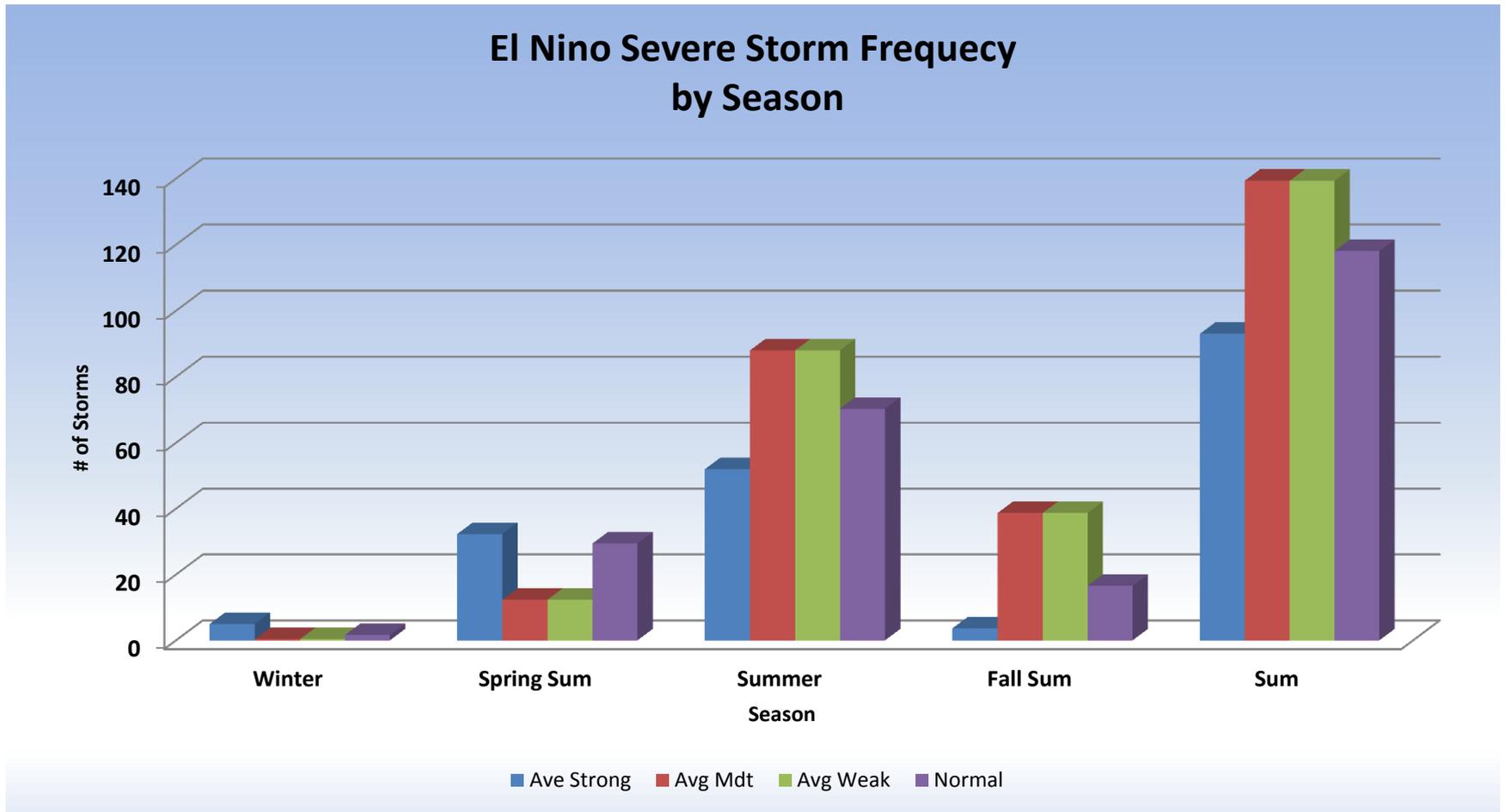
Severe Weather Trends

- There is a statistically significant increase in severe storm frequency since the 1950's to the past 10 years
- Most of this increase is related to how we gathered the data
 - Different MIC's had different methods to gather the data
 - Charles Snyder ...1970's and 1980's
 - Dean Gulezian.....1990's
 - Dan H.1996-2007
 - Dan C.since @2007

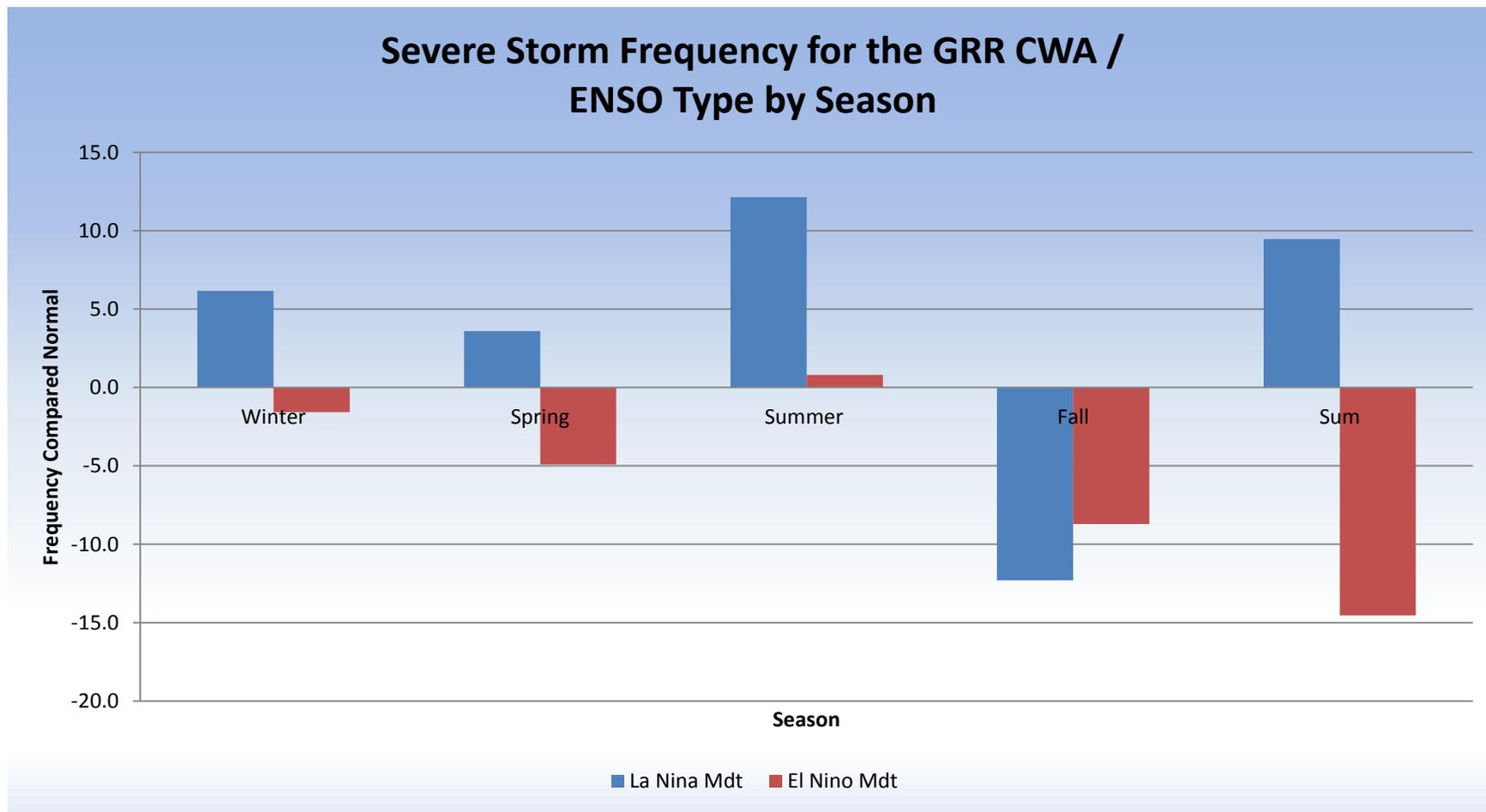
La Nina And Storm Frequency By Season



EL Nino Storm Frequency By Season



Does ENSO Impact Seasonal Storm Frequency ?



Trends in Severe Storms Due to ENSO Phase

- For both winter, spring, and summer La Nina has a significant increase in the numbers of events compared to El Nino
 - Average 6 more in the winter, compared to El Nino
 - Average 8 more in the spring, compared to El Nino
 - Average 10 more in the summer
- Fall sees a suppression for both compared to ENSO neutral
- For the entire season there is typically 24 more severe storm events during La Nina years

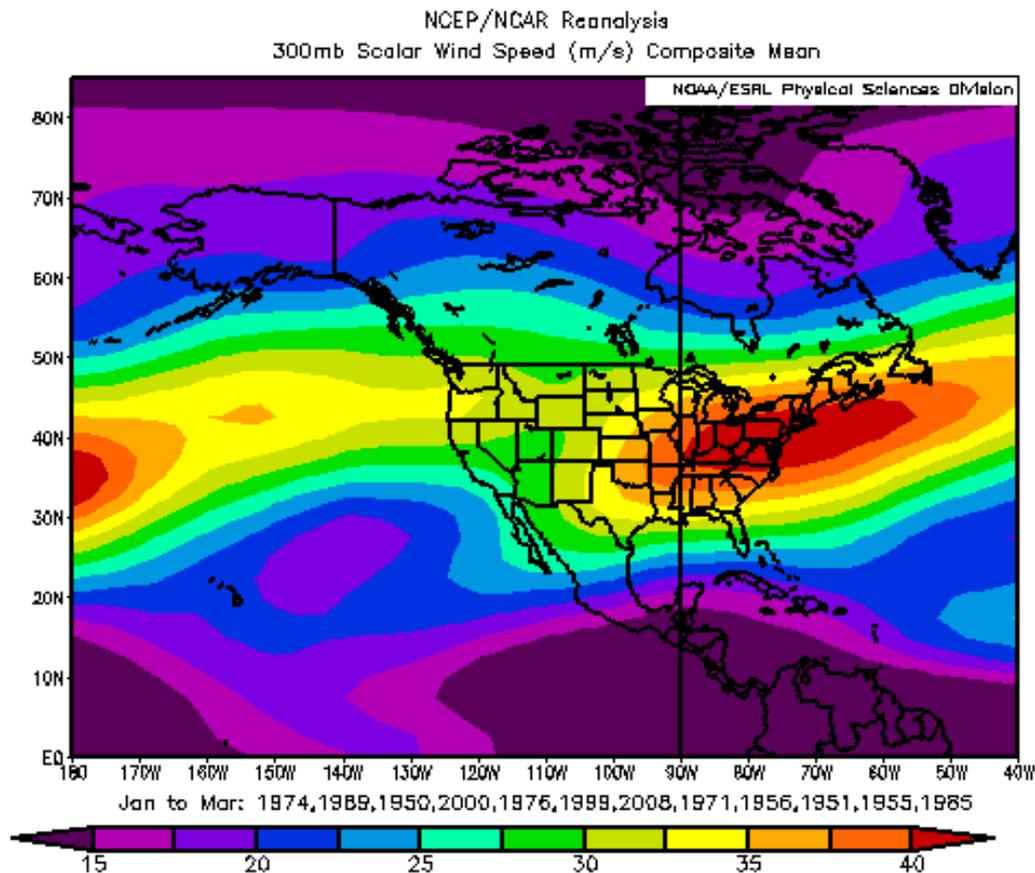
Let's see why there would
be a difference



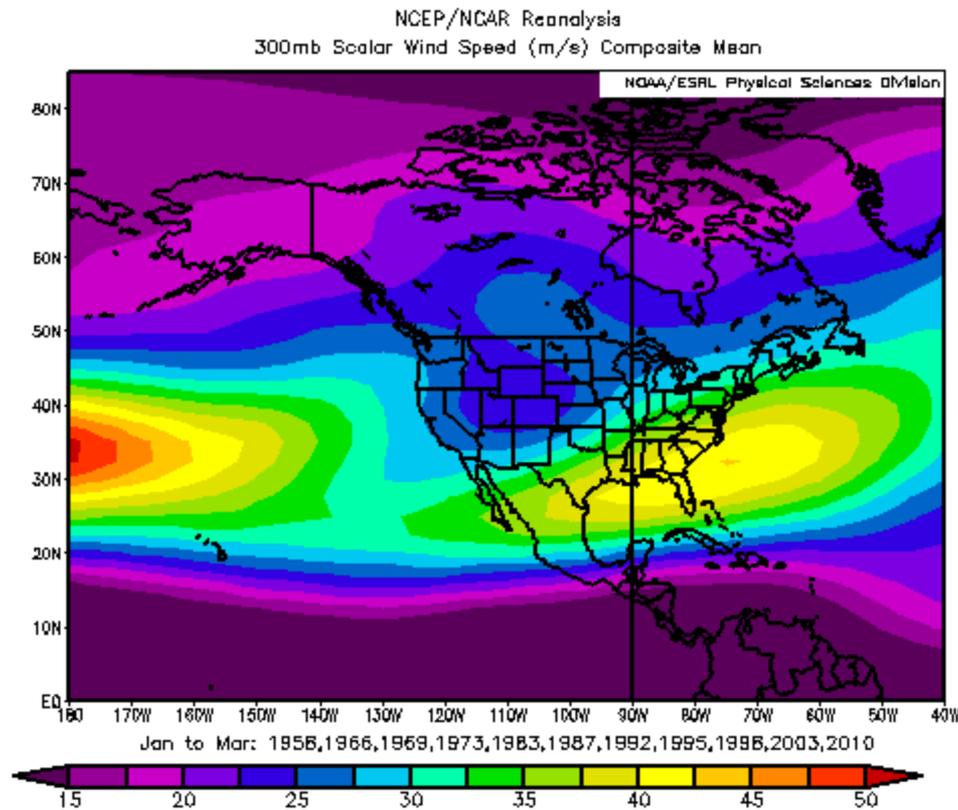
A photograph of a house with a lightning bolt striking the sky above it. The house is a single-story structure with a brown roof and light-colored siding. The sky is overcast and grey, with a bright white lightning bolt striking down from the top left. The text is overlaid in red with a white outline.

We will look at the 300
mb mean jet core for
both La Nina and El Nino
years

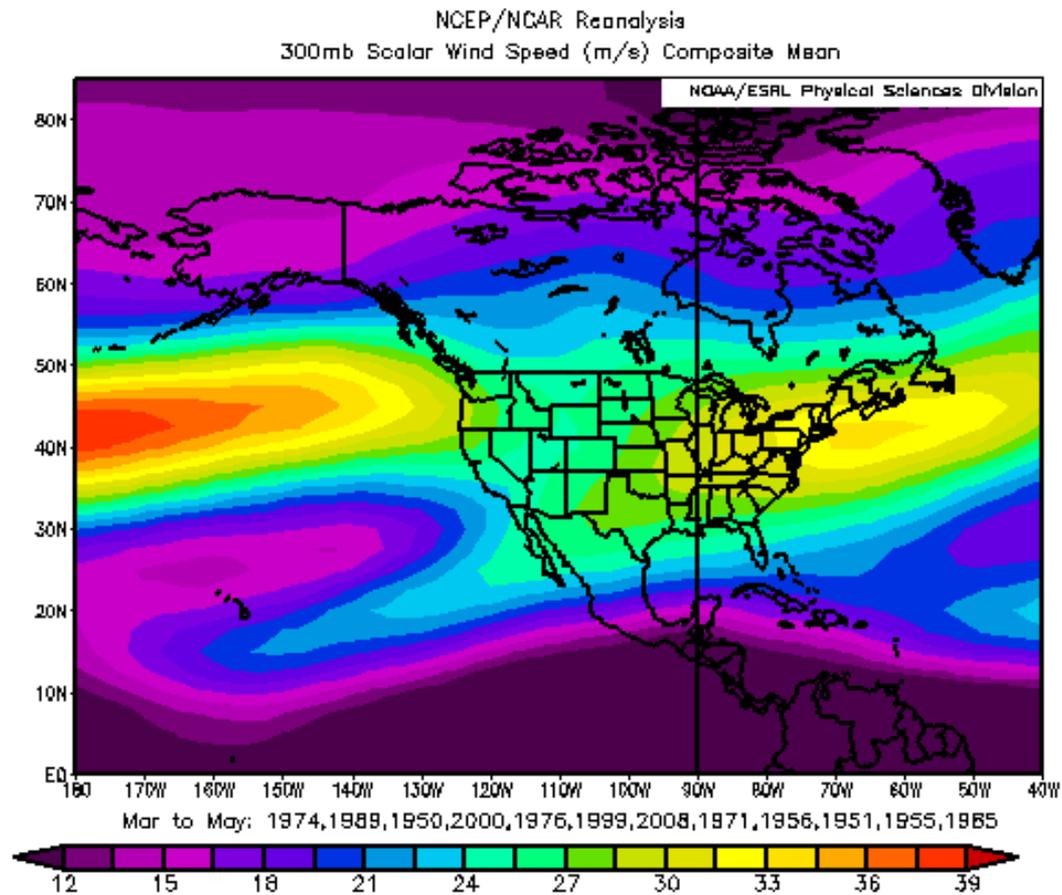
Moderate or Strong **La Nina** Winter Mean 300 mb Scalar Wind Speed



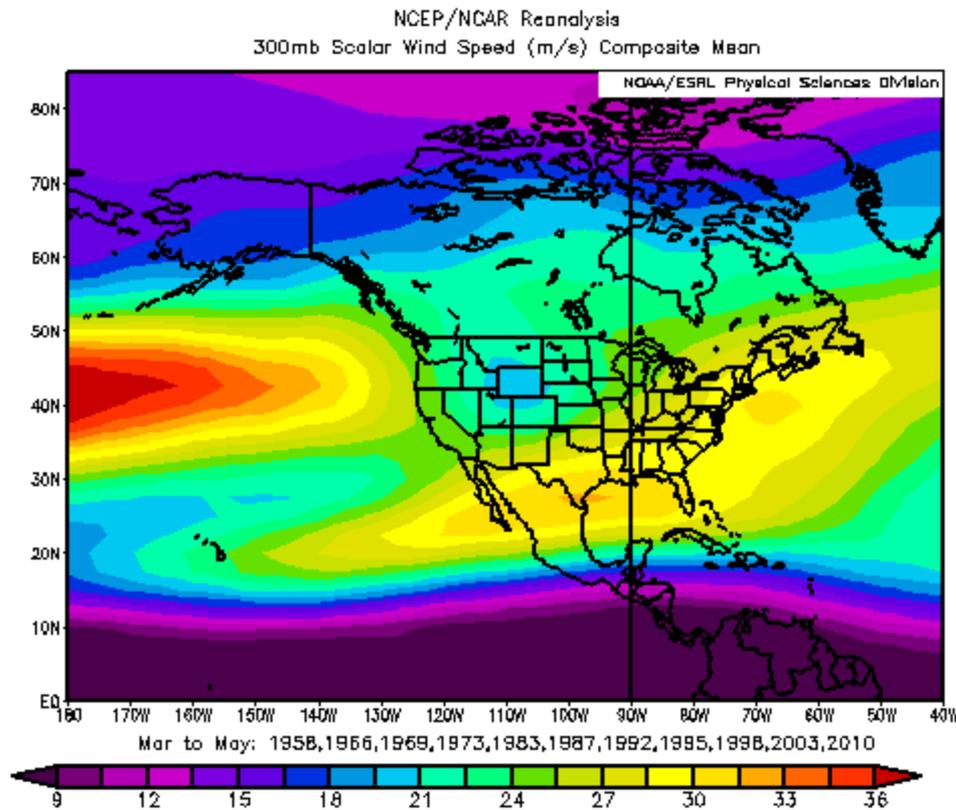
Moderate or Strong **El Nino** Winter Mean 300 mb Scalar Wind Speed



Moderate or Strong **La Nina** Spring Mean 300 mb Scalar Wind Speed



Moderate or Strong **El Nino** Spring Mean 300 mb Scalar Wind Speed



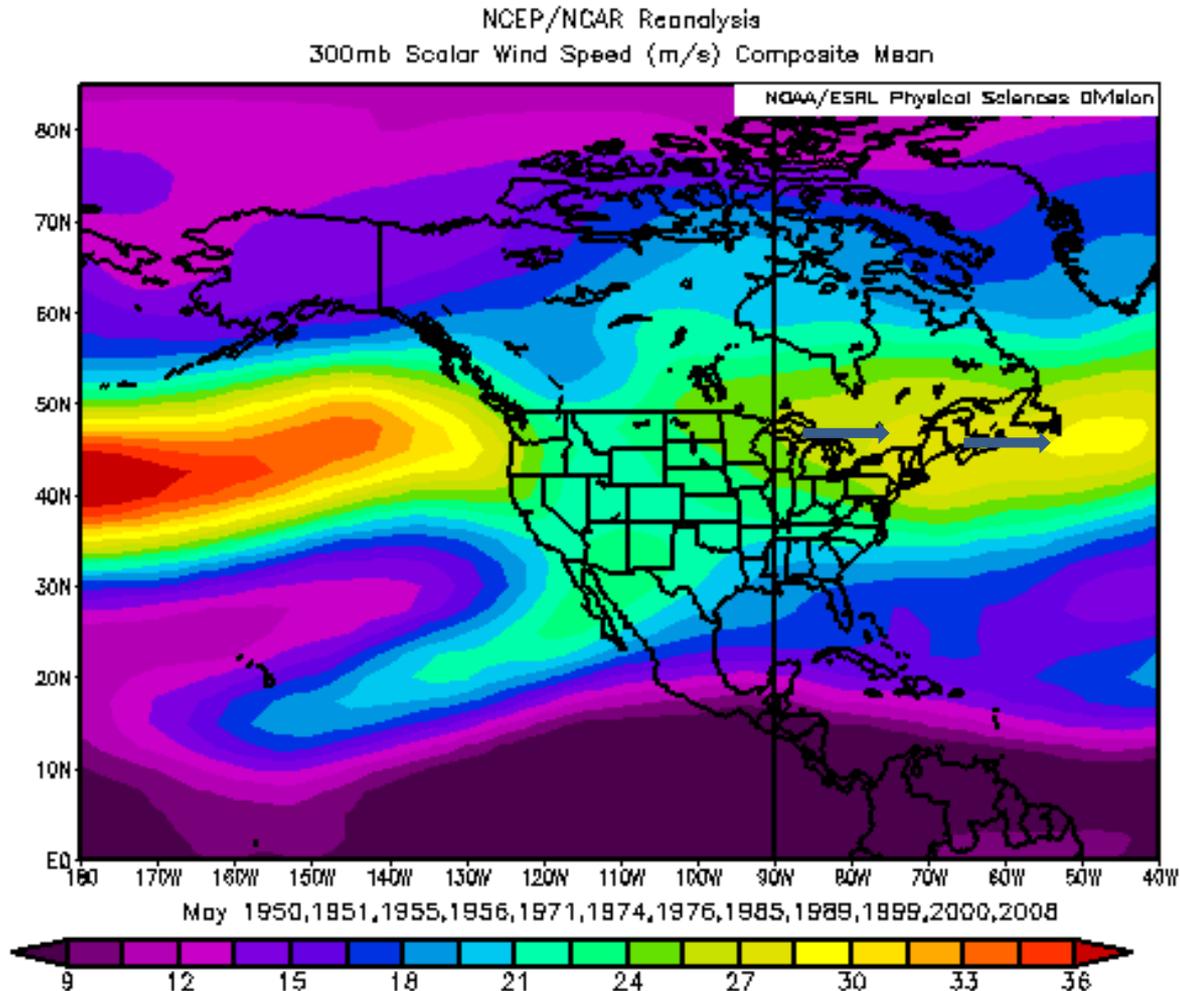
*Spring is March through May, but most of our severe storms are May through August

So, lets look at the jet core in May to see how far north it gets during a typical La Nina Spring

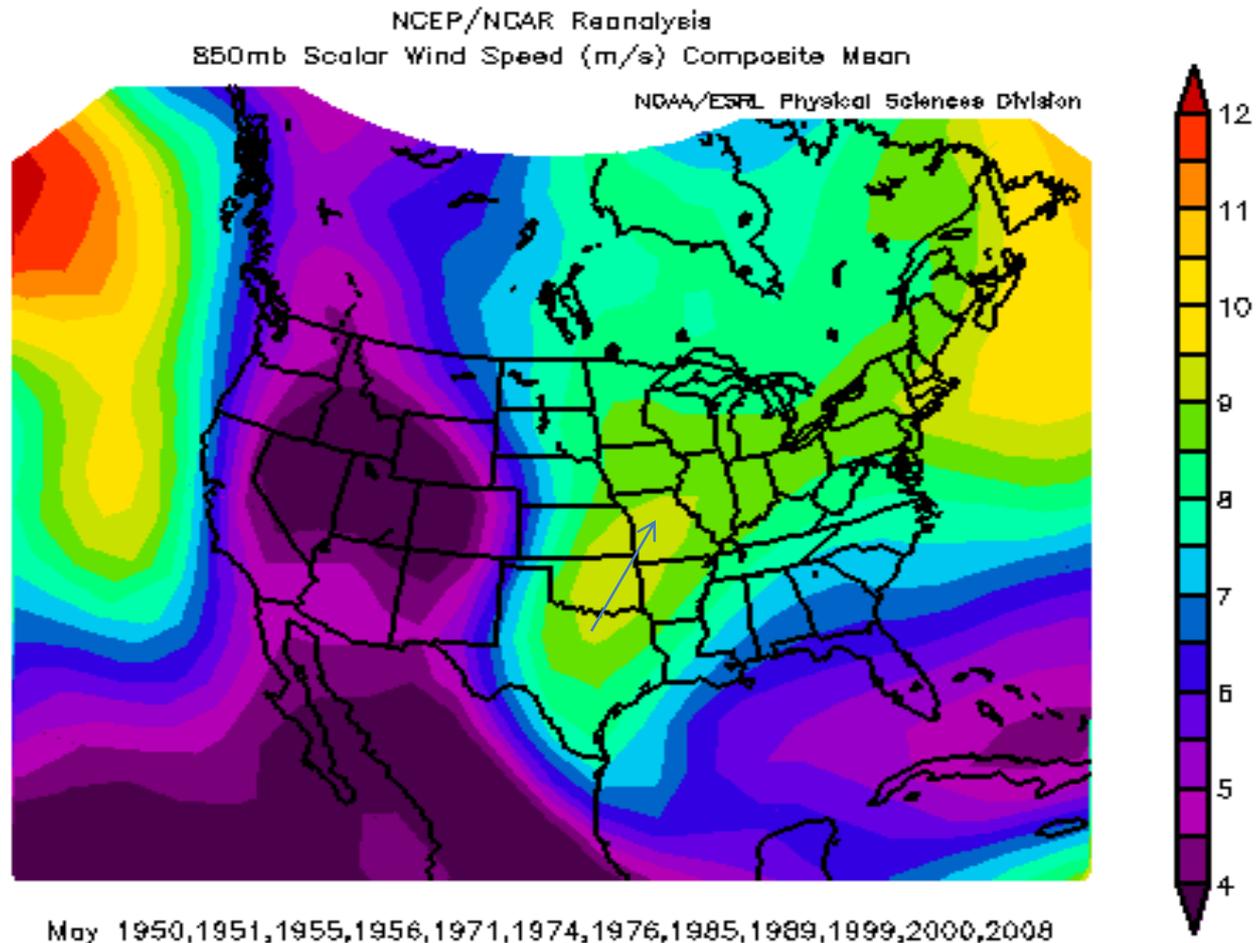


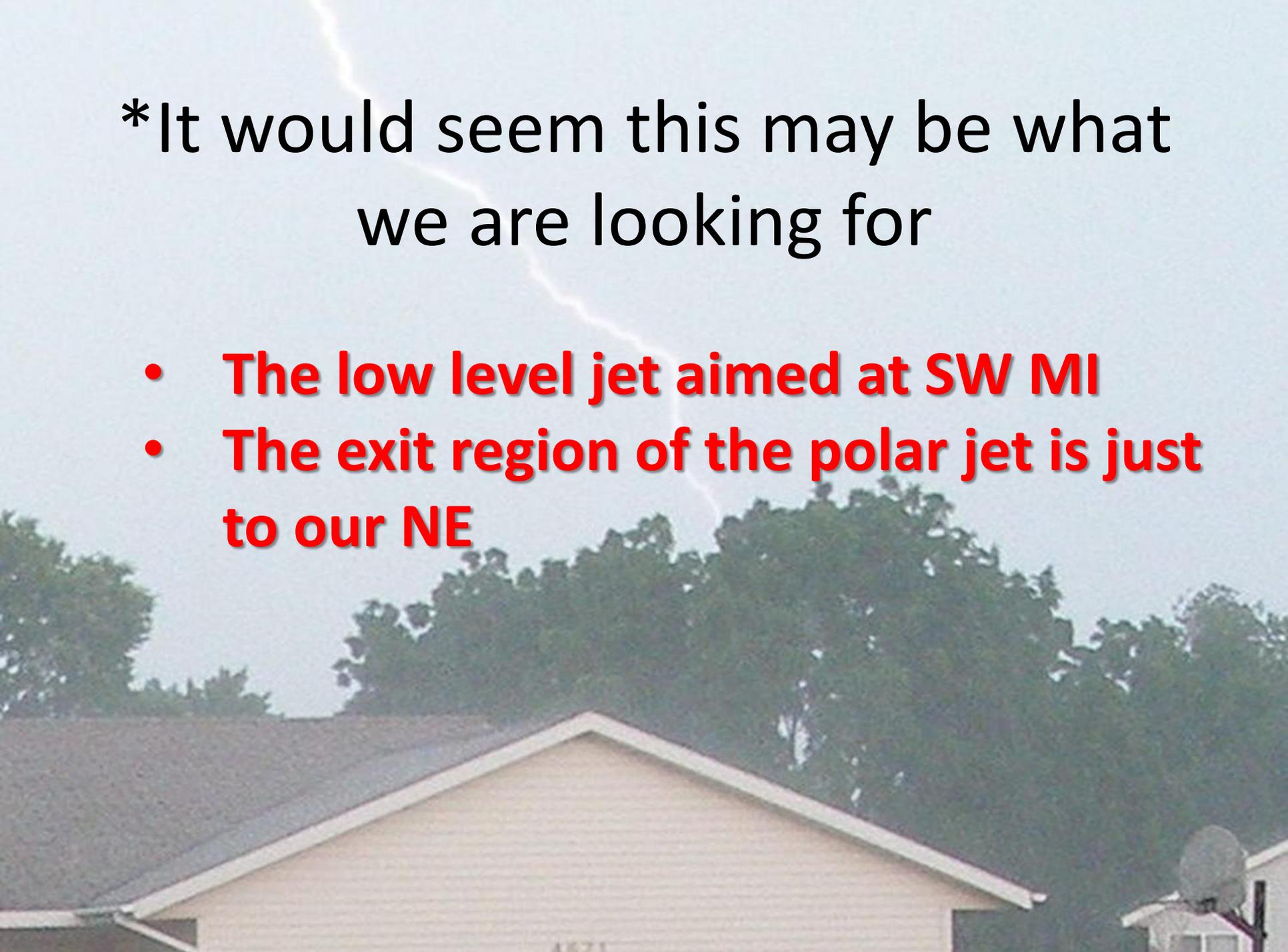
300 mb Jet Core in May

SW MI in the entrance region of Jet



Note the 850 mb jet location for May during Moderate La Nina's



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*It would seem this may be what we are looking for

- **The low level jet aimed at SW MI**
- **The exit region of the polar jet is just to our NE**

Conclusions

- **There is a statistically significant increase in severe storms and tornados during La Nina years**
- **Seems the jet core is farther north in both the winter and spring during La Nina years**
- **Since severe storms are typically related to high winds and jet level, it would make sense the Grand Rapids CWA would see more frequent severe storms during La Nina years than for El Nino year**